I claim:

1. A method for inducing pulsations in a system for treating materials comprising at least one liquid,

said system comprising at least one float positioned at the top of said liquid, a gas distribution means for emitting gas in form of bubbles in said liquid, said gas distribution means is positioned underneath said at least one float and braced to said at least one float by at least one brace, said gas distribution means is connected to a source of gas by a conduit having at least one flexible part,

said method comprising steps of (a) emitting gas at a predetermined initial flow rate from a gas distribution means in said liquid and producing a gas-liquid mixture having density less than the density of said liquid, (b) at least partially sinking said at least one float in said mixture whereby said gas distribution means is submerged to a greater depth and said gas flow rate at said greater depth is reduced and said density of said mixture increases, (c) at least partially rising said floats in said mixture and increasing said gas flow rate, and repeating steps (b) and (c), whereby rising and sinking of said at least one float produces pulsations of said gas distribution means within the range of pulsations, wave-like emission of said gas bubbles, and pulsating motion of said liquid in said system, and whereby said floats and said diffusion means pulsate within a range of pulsations.

2. A method of pulsating reacting mixtures in an apparatus with at least one float and at least one gas diffusion means disposed under said float and connected to said float by at least one brace, said diffusion means is flexibly connected to a source of gas, comprising steps of alternating sinking and floating of said float and said diffuser, whereby the rate of gas emission by said diffusion means increases at the upper positions, within the range of

pulsation of the float and diffusion means thus decreasing the density of the liquid-gas mixture and causing the float and diffusion means to sink, and the rate of gas emission by said diffusion means decreases at the lower positions, within the range of pulsation, of the float and diffuser thus decreasing the density of the liquid-gas mixture and causing the float and diffuser to rise.

3. The method of Claim 1, wherein said reacting is selected from the group of mass transfer, chemical and biological transformations, phase separations, thickening of suspensions, mixing, suspending of particles, washing, coagulation-flocculation, membrane filtration, filtration across particulate media, filtration across floating media, mass transfer across membrane, and combinations thereof.

4. The method of claim 3, wherein said mass transfer processes are selected from the group comprising gas absorption, gas desorption, aeration, deaeration, adsorption with granular adsorbent, adsorption with powdered adsorbent, adsorption by biomass, ion exchange, extraction, and combinations thereof.

5. The method of claim 3, wherein said chemical transformations are selected from the group comprising precipitation, crystallization, dissolution, oxidation-reduction, acid-base conversions, substitution, hydrolysis, polymerization, and combinations thereof.

6. The method of Claim 5, wherein said oxidation-reduction steps are selected from the group comprising chemical oxidation-reduction steps, electrochemical oxidation-reduction steps, biological oxidation-reduction steps, and combinations thereof.

7. The method of claim 3, wherein said biological transformations are selected from the group comprising strictly anaerobic processes, methanogenic processes, sulfur reduction processes, ferric ion reduction processes, fermentation processes, acidification processes, denitrification processes, microaerofilic processes, air based aerobic processes, ferrous

iron oxidation processes, nitrification processes, oxygen based aerobic processes, and combinations thereof.

8. The method of claim 3, wherein said mass transfer processes are selected from the group comprising gas absorption, gas desorption, adsorption with granular adsorbent, adsorption with powdered adsorbent, adsorption by biomass, ion exchange, extraction, and combinations thereof.

9. The method of claim 3, wherein said phase separation is selected from the group comprising gravity settling, suspended sludge blanket separation, fluidized bed separation, flotation, and combinations thereof.

10. The method of claim 3, wherein said membrane filtration is selected from the group comprising filtration with hollow fiber membranes, filtration with flat membranes, filtration with nanomembranes, filtration with microfilter membranes, and combinations thereof.

11. The method of claim 1, wherein said gas is selected from the group of air, oxygen, nitrogen, nitrogen oxides, inert gases, carbon dioxide, carbon monoxide, sulfur dioxide, hydrogen sulfide, ammonia, chlorine, ozone, organic gases, methane, fuel gas, propane, water vapor, steam, low pressure water vapor under vacuum, and combinations thereof.

12. The method of claim 1, wherein said source of gas is selected from the group comprising compressors, blowers, vacuum compressors, vacuum blowers, jet vacuum means, jet compression means, tanks with compressed gas, and combinations thereof.

13. The method of Claim 1, wherein said range of pulsations is determined by factors selected from the group comprising a specific carrying capacity of said floats, said gas emission rate, hydraulic characteristic of said source of gas, said conduit, riser, and diffusion means, mass and inertia of said system, and combinations thereof.

14. The method of Claim 5, wherein said specific carrying capacity of said floats increases (decreases) when ratio width to height in the vertical cross-section of said floats increases (decreases), whereby said range of pulsations is reduced (increased).

15. The method of Claim 1, wherein said vertical cross-section of said floats is selected from the group comprising round section, vertically elongated section, vertically elongated rectangular section, vertically tapered section with wider top, vertically tapered section with wider bottom, vertically flat section, sections with openings, sections with holes, and combinations thereof, whereby the range and the frequency of pulsations are determined by said selected cross-sections.

16. The method of Claim 1, wherein multiple said systems are used simultaneously.

17. The method of claim 1, and further providing a step of self-propulsion by providing asymmetrical discharge of said liquid from said system of said system, whereby said step of self-propulsion is selected from a group comprising circular motion of said system, linear motion of said system, reciprocal motion of said system, motion along a predetermined curve, and combination thereof.

18. The method of Claim 17, wherein said step of circular motion comprises steps of feeding said gas from the bottom of a vertical standpipe with at least one opening at the top, said vertical stand pipe is cupped with a vertical pipe having open bottom and closed top and at least one side branch for conducting said gas to said system, said system having said asymmetrical discharge in a predominantely tangential direction relative said circular motion, whereby said cupping pipe with said branch and said system freely rotate around said vertical standpipe.

19. The method of claim 17, wherein said step of reciprocal motion is provided by alternating steps of terminal switching of said asymmetrical discharge in opposite directions.

20. The method of Claim 17, wherein said self-propelled motion is directed along directing means, whereby said directing means are selected from the group comprising a pivotal structure and at least one arm with said at least one system secured to said arm, at least one linear rail, at least one curvilinear rail, at least one closed line rail, at least one linear cable, at least one curvilinear cable, at least one closed line cable, and combinations thereof.

21. An apparatus for producing pulsation motion in at least one liquid being treated comprising at least one float, at least one gas diffuser, said diffuser is flexibly connected to a source of said gas, said gas is emitted from said diffuser in form of bubbles floating up along a predominantly vertical path wherein said diffuser is connected to said float by at last one brace, and said at least one float is positioned in said path of bubbles emitted by said diffuser, whereby said gas and said liquid produce a gas liquid mixture with varying density and said float and said diffuser are alternatingly sinking and rising in a pulsating manner, whereby said apparatus is used in conjunction with said treatment selected from a group comprising mass transfer, chemical and biological transformations, phase separations, thickening of suspensions, mixing, suspending of particles, washing, coagulation-flocculation, membrane filtration, filtration across particulate media, filtration across floating media, mass transfer across membrane, and combinations thereof.

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